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LARGE AREA CROP INVENTORY EXPERIMENT (LACIE)



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LACIE TRANSITION YEAR OPERATIONS PLAN



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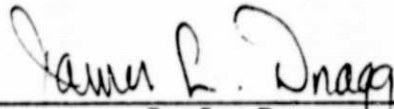
Lyndon B. Johnson Space Center
Houston, Texas 77058

DECEMBER 1977



LARGE AREA CROP INVENTORY EXPERIMENT (LACIE)
TRANSITION YEAR OPERATIONS PLAN

APPROVED BY



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CONTENTS

Section	Page
1. TRANSITION YEAR OBJECTIVES	1-1
1.1 <u>PRIMARY OBJECTIVE</u>	1-1
1.2 <u>SPECIFIC OBJECTIVES</u>	1-1
2. SCOPE.	2-1
3. OPERATIONAL PRIORITIES	3-1
4. DATA ACQUISITION AND LOADING	4-1
4.1 <u>SEGMENT ALLOCATION</u>	4-1
4.2 <u>DATA LOADING</u>	4-1
4.2.1 GODDARD SPACE FLIGHT CENTER PROCESSING.	4-2
4.2.2 PRODUCTION FILM CONVERTER/PHOTOGRAPHIC TECHNOLOGY LABORATORY/LACIE PHYSICAL DATA LIBRARY PROCESSING.	4-4
4.2.3 GROUND DATA SYSTEMS DIVISION COMPUTER SUPPORT	4-4
4.2.4 CROP ASSESSMENT SUBSYSTEM AGGREGATIONS AND REPORTS	4-5
4.2.5 YIELD ESTIMATION SUBSYSTEM ESTIMATES AND CROP CALENDAR ADJUSTMENTS	4-5
5. OPERATIONAL APPROACH	5-1
5.1 <u>ERIPS LANDSAT DATA ANALYSIS</u>	5-2
5.1.1 TRANSITION YEAR DATA ORDERS AND LANDSAT ACQUISITION STRATEGY.	5-2
5.1.2 NON-LANDSAT DATA ACQUISITION.	5-4
5.1.3 CAMS ANALYSIS APPROACH.	5-4
5.1.4 YIELD ESTIMATES AND CROP CALENDARS.	5-8
5.1.5 CAS MONTHLY REPORTS	5-9

Section	Page
5.1.6 ACCURACY ASSESSMENT	5-10
5.2 <u>USDA ATS SUPPORT</u>	5-11

Appendix

A. LANDSAT DATA ACQUISITION PLAN FOR TRANSITION YEAR. . .	A-1
B. AUSTRALIA PROCESSING PLAN FOR DECEMBER CAS MONTHLY REPORT	B-1
C. U.S.S.R. EARLY SEASON PROCESSING PLAN.	C-1

PREFACE

This document presents the plans for Large Area Crop Inventory Experiment (LACIE) Transition Year operations and the general approach for meeting LACIE Transition Year objectives by the participating organizations, the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, and the U.S. Department of Agriculture (USDA). Its purpose is to provide an integrated approach for subsystems handling, processing, and analyzing data and for generating reports in a timely manner.

Detailed requirements are contained in the LACIE subsystem requirements documents. Operating procedures are contained in the subsystem detailed procedures. The detailed operating plan and procedures for the USDA Applications Test System (ATS) will be developed by the USDA and issued separately from this document. Specific LACIE operations plans and procedures in support of the USDA ATS will be developed as its interfaces with the LACIE are developed.

1. TRANSITION YEAR OBJECTIVES

1.1 GENERAL OBJECTIVES

The general objectives of the LACIE Transition Year are:

- a. To facilitate and/or assist in the orderly transfer of LACIE technology to the USDA ATS
- b. To expand the data base for evaluation of LACIE technology over the U.S.S.R.
- c. To evaluate the performance of LACIE technology over new regions and identify new problems
- d. To develop and evaluate new and/or improved methodologies for crop inventory and/or assessment

1.2 SPECIFIC OBJECTIVES

The specific objectives of the LACIE Transition Year are:

- a. To determine the benefits and efficiencies of the new sampling strategy with stratification according to agrophysical units in at least one country
- b. To evaluate the performance of advanced yield models, of baseline yield models and adjustable crop calendars (ACC's) in an area where wheat is of the dwarf variety with a significant amount of it irrigated, and of yield models using different parameters for moisture assessment
- c. To determine the adequacy of direct discrimination of wheat
- d. To evaluate improved procedures for estimating emergence
- e. To gain a better understanding of the bias in estimates from the extended length of analysis
- f. To determine the adequacy of the LACIE technology in an area where small fields predominate

- g. To determine the applicability of the LACIE baseline technology to new situations in areas with different climatic conditions and low latitudes and where ancillary data are minimal
- h. To provide for initial evaluation of the USDA ATS performance
- i. To gain an understanding of the vagaries of yet another year of processing data for given countries
- j. To evaluate the benefits of the additional capabilities of the Landsat-C for crop inventory and/or assessment
- k. To continue supporting research and development in crop acreage, yield, and production estimation.

2. SCOPE

The LACIE Transition Year quasi-operational activity has been defined for the period starting in the fall of 1977 and continuing through the spring of 1979. The Transition Year represents a culmination of various improvements, expansion to the Southern Hemisphere, and a final test in the LACIE context prior to transfer to USDA of the latest baseline technology for applications testing. Specifically, the areas to be studied by LACIE are as follows:

- a. The U.S. Great Plains and U.S. and Canadian intensive test sites (ITS's) - to be worked in real time with the most advanced technology available and the results reported monthly
- b. India, one state (Punjab) - to be worked with baseline technology in real time or approximately real time and the results reported at monthly intervals, after adequate crop emergence, throughout the growing season
- c. The U.S.S.R. selected sites of the winter- and mixed-wheat growing regions - to be worked using baseline technology and reporting early, midseason, and at-harvest estimates
- d. The Southern Hemisphere (Australia, Argentina, and Brazil) - to be worked using baseline technology and analyzing the 1977 crop year to obtain two (midseason and at-harvest) estimates during the analysis period

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3. OPERATIONAL PRIORITIES

The general processing priorities to be followed for the Transition Year are as follows:

- a. U.S.S.R. mixed wheat - 70 to 80 segments for analysis on the USDA ATS during the period from December 1977 through February 1978
- b. U.S.S.R. spring wheat for analysis on the USDA ATS
- c. ITS's in the United States and Canada
- d. U.S. Great Plains spring wheat
- e. U.S. Great Plains mixed wheat
- f. U.S. Great Plains winter wheat
- g. U.S.S.R. winter wheat
- h. U.S.S.R. mixed wheat
- i. India - for analysis on the Classification and Mensuration Subsystem (CAMS) Interactive Multispectral Image Analysis System, model 100 (Image 100), Hybrid System
- j. Australia
- k. Argentina
- l. Brazil
- m. Canada blind sites - for analysis on the USDA ATS
- n. Canada blind sites - for analysis on the Earth Resources Interactive Processing System (ERIPS)

4. DATA ACQUISITION AND LOADING

4.1 SEGMENT ALLOCATION

Segments will be allocated in the following manner.

U.S. ITS's	24
U.S. winter wheat	288
U.S. mixed wheat	75
U.S. spring wheat	124
U.S.S.R. winter and mixed wheat	~750
U.S.S.R. spring wheat	790
India	33
Argentina	165
Australia	257
Brazil	50
Canada blind sites and ITS's	<u>40</u>
Total segments	~2596

4.2 DATA LOADING

The number of segments active in the system and the number of Landsat acquisitions are shown in figures 1 and 2. In the Transition Year, an estimated 1766 segments with about 11 000 acquisitions will be received by LACIE, and approximately 830 segments with approximately 3200 acquisitions will be received by the USDA ATS.

4.2.1 GODDARD SPACE FLIGHT CENTER PROCESSING

The Goddard Space Flight Center (GSFC) will acquire and process Landsat full-frame and sample-segment data for the ~2596 segments. The maximum number of segments for which Landsat data will be collected at any one time is about 2100 segments. The maximum number of acquisitions shipped weekly to the Lyndon B. Johnson Space Center (JSC) is estimated to be 471 acquisitions.

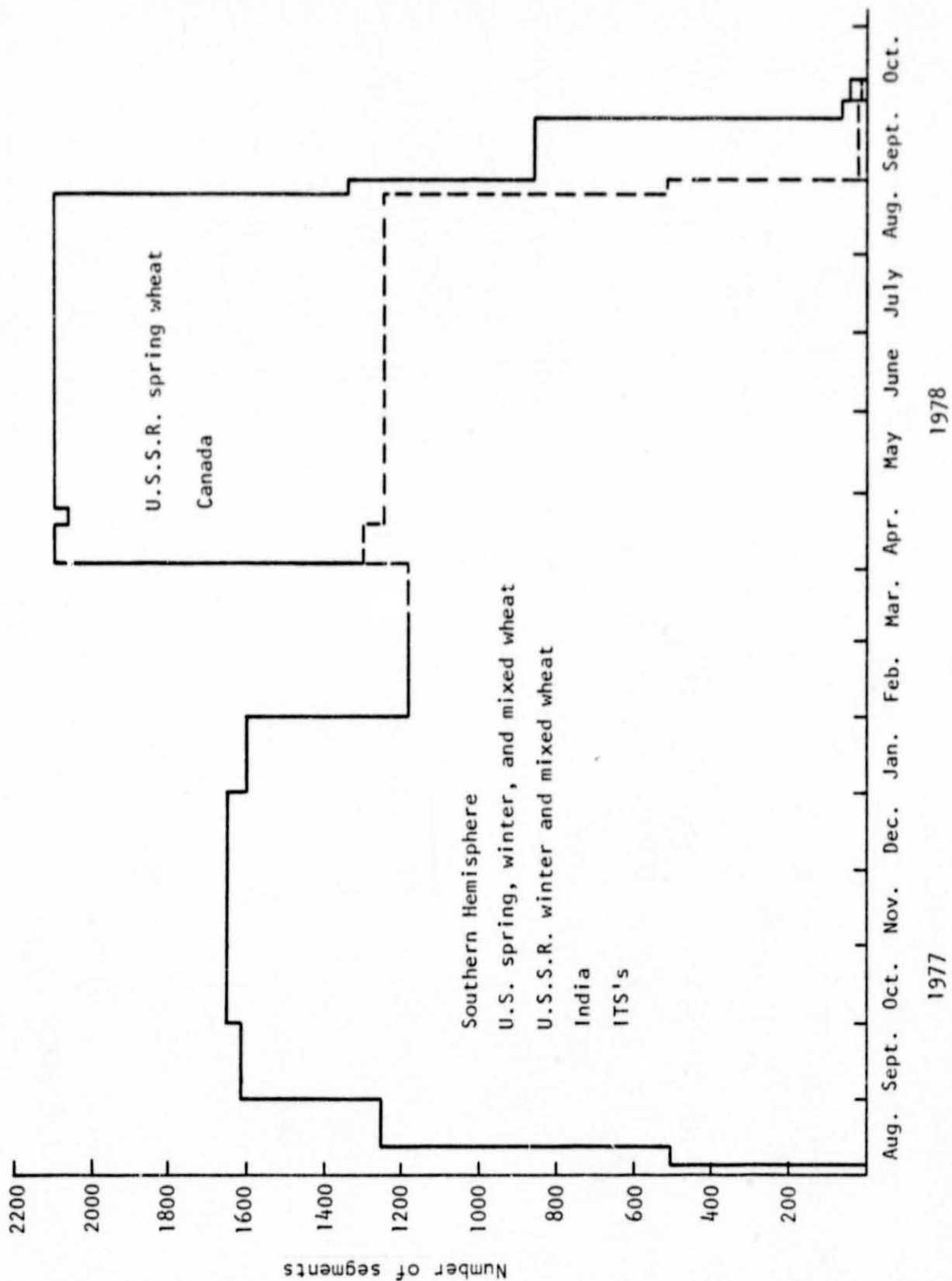


Figure 1.- Transition Year active segments.

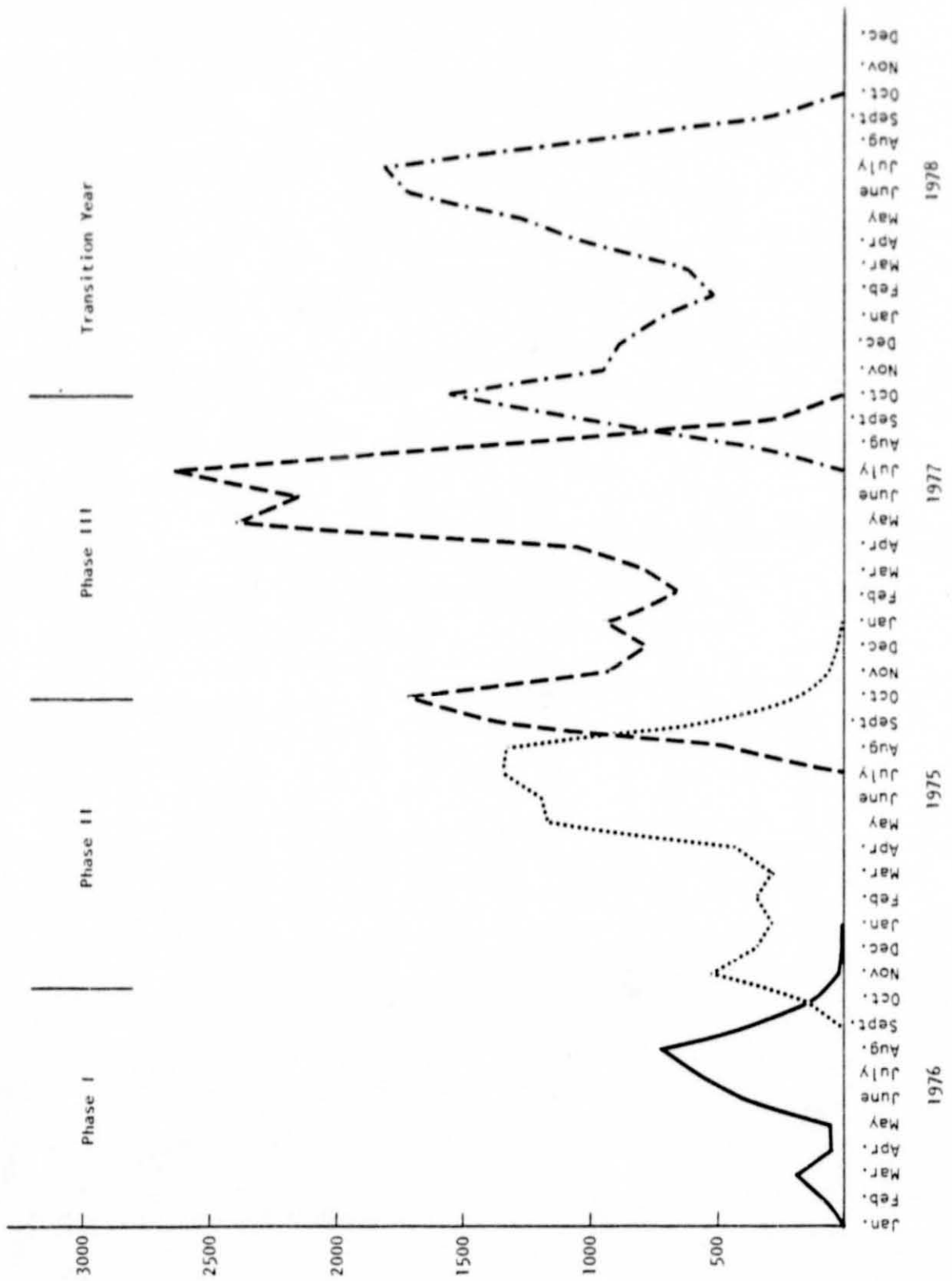


Figure 2.- LACIE predicted data.

This compares with the Phase III requirements of 2869 active segments and 688 acquisitions. The maximum estimated 4-week average weekly data load is 408 acquisitions, which appears to be within the capabilities of the GSFC.

The lessening of the Transition Year data load by about 30 percent from Phase III is expected to enable the GSFC to maintain processing capability within the specified time line. The magnitude of the backlog experienced in Phase III is not expected to occur in the Transition Year, inasmuch as its requirement is less than the GSFC-stated maximum of 480 acquisitions shipped per week and is considerably less than the weekly average of 610 acquisitions shipped during June and July 1977.

4.2.2 PRODUCTION FILM CONVERTER/PHOTOGRAPHIC TECHNOLOGY LABORATORY/LACIE PHYSICAL DATA LIBRARY PROCESSING

An analysis of the processing requirements for the production film converter (PFC), the Photographic Technology Laboratory (PTL), and the LACIE Physical Data Library (LPDL) indicates that each will be able to process the expected acquisitions from the GSFC and the ERIPS batch products. However, with the addition of the new dot overlay and cluster map products and the anticipated USDA ATS requirements, the 40 hours of PFC time per week will be barely adequate. Improvements in efficiencies are being investigated which, when implemented, will help alleviate the situation. Additionally, not all acquisitions which are processed through the PFC will have the entire contingent of products generated, as is the case with the USDA ATS segments.

4.2.3 GROUND DATA SYSTEMS DIVISION COMPUTER SUPPORT

The Ground Data Systems Division (GDSD) at JSC will provide 40 hours of IBM 360/75 computer time during the Transition Year. Two hours per week will be required for image copying; an average of slightly less than 2 hours per week will be required for image

update based on the projected workload profile. This will leave about 36 hours per week for batch processing and for quality assurance. This batch processing capability is anticipated to be adequate to meet the average processing requirements. Processing improvements incorporated into scheduled future software deliveries are expected to reduce the processing time per batch run, thus providing additional capability. The USDA ATS will use a separate and self-contained system with no impact on GDSD operations except for image updates and image unload time.

4.2.4 CROP ASSESSMENT SUBSYSTEM AGGREGATIONS AND REPORTS

The Crop Assessment Subsystem (CAS) is expected to aggregate and produce approximately 18 scheduled reports for the Transition Year, in addition to annual reports. Reports are planned to be issued for six countries. The CAS aggregation software will reside on the Programmed Data Processor, model 11/45 (PDP 11/45), support processor and will be used to generate reports utilizing data processed and analyzed by the LACIE and the USDA ATS. The CAS reports will be generated via computer terminals in the Green Room (JSC Building 17), and all CAS processing and reporting will be controlled through these terminals. Sufficient time is allocated on the support processor for generating the LACIE reports, and the support processor will also be required to support the USDA ATS reporting requirements. Although time may be adequate to support these reports, scheduling reports, users, and computer time will have added importance.

4.2.5 YIELD ESTIMATION SUBSYSTEM ESTIMATES AND CROP CALENDAR ADJUSTMENTS

The Yield Estimation Subsystem (YES) will provide yield estimates and crop calendar adjustments for 13 percent fewer segments; however, it will provide yield estimates and crop calendar adjustments for seven countries in the Transition Year, as

compared to three countries in Phase III. Operational yield models exist for all areas scheduled to be worked in the Transition Year.

The crop calendar models for the Transition Year are available and will be issued biweekly for all areas. Adjusted crop calendar data are not planned to be issued for the one state in India for the Transition Year.

5. QUASI-OPERATIONAL APPROACH

During the Transition Year, the LACIE will continue to be the experimental system for demonstrating and evaluating the technology for estimating global wheat production. However, a primary LACIE objective will be to facilitate and assist in the orderly transfer of LACIE technology to the follow-on USDA ATS. Thus, operations activities during the Transition Year will emphasize the transfer of technology, as well as the demonstration and evaluation of new technologies.

In order to respond effectively to the Transition Year objectives, it is planned to issue a series of documents throughout the Transition Year detailing specific strategies to meet specific operational requirements. This approach will be employed during the Transition Year, inasmuch as the interfaces and data handling systems are well documented and remain basically unchanged from previous phases. This will also facilitate the development of more realistic operational plans, since the results of the latest technical developments can be incorporated into the planning and should enable the operational system to be responsive to these developments.

The following plans are anticipated to be developed during the Transition Year:

<u>Plan</u>	<u>Target date for completion</u>
Landsat Data Acquisition Plan for Transition Year (appendix A)	November 7, 1977
Australia Processing Plan for December CAS Monthly Report (CMR, appendix B)	November 15, 1977
U.S.S.R. Early Season Processing Plan (appendix C)	November 28, 1977

<u>Plan</u>	<u>Target date for completion</u>
U.S. Winter Wheat Processing Plan	December 12, 1977
India Processing Plan	January 9, 1978
Southern Hemisphere Processing Plan for March Report	February 10, 1978
U.S.S.R. Midseason/Late Season Processing Plan	April 10, 1978
U.S. Spring Wheat Processing Plan	May 15, 1978
LACIE Operations Support Plan for USDA ATS	April 14, 1978, preliminary June 2, 1978, final
Plan for Closeout of Transition Year Processing	August 11, 1978

Copies of the first three of these plans are contained in appendixes A, B, and C, respectively.

5.1 ERIPS LANDSAT DATA ANALYSIS

5.1.1 TRANSITION YEAR DATA ORDERS AND LANDSAT ACQUISITION STRATEGY

5.1.1.1 Data Orders

The initial Transition Year data orders are listed in the following table. All of the U.S.S.R.-allocated winter- and mixed-wheat segments were ordered pending a project decision on the specific set of segments to be worked during the Transition Year. Once that decision is made, the Landsat data order will be reduced accordingly. The U.S.S.R. spring-wheat and Canadian segments were ordered in anticipation of a USDA ATS requirement. This order, too, will be modified as necessary to conform to USDA ATS requirements.

The Landsat data for the three Southern Hemisphere countries were ordered at a time which made it possible for Landsat data

<u>Data</u>	<u>Number of segments</u>
U.S. winter wheat	363
U.S. spring wheat	124
U.S. ITS's	24
U.S.S.R. winter and mixed wheat	1157
U.S.S.R. spring wheat	790
U.S.S.R. ITS	1
India	33
Canada	30
Canada ITS's	10
Australia	257
Argentina	165
Brazil	<u>50</u>
Total	3004

collection to begin in late August 1977 and to be telemetered to U.S. ground stations. Prior to this date, data were not collected by Landsat for Australia. However, real-time data were collected prior to August 1977 by Landsat for Brazil and Argentina and were down-linked to the Brazil ground station. Arrangements have been made for recorded data from the Brazil ground station to be obtained and processed retrospectively at the GSFC. Acquisitions beginning April 15, 1977, for Argentina and beginning May 1, 1977, for Brazil will be processed and transmitted to JSC for analysis.

Arrangements were made with the Brazilian Government for direct transmission of Brazil and Argentina sample-segment data to the Brazil ground station beginning with data collected from Landsat passes after September 29, 1977. These data will be provided to GSFC for processing. This procedure was implemented to take advantage of the Brazil ground station's ability to receive

Landsat data, thereby relieving the Landsat tape recorder of Brazil and Argentina acquisition requirements. However, because of the time required to transmit the data from Brazil to GSFC, the time for receiving the data at JSC will be extended significantly. This, in effect, may make it unlikely that an early/midseason report for Brazil and Argentina can be made in December 1977, as scheduled.

The U.S. and India data orders are expected to remain constant for the Transition Year.

5.1.1.2 Landsat Acquisition Strategy

The strategies for acquisition of data by Landsat-2 and the evaluation, implementation, and utilization of Landsat-C during the Transition Year are contained in appendix A.

5.1.2 NON-LANDSAT DATA ACQUISITION

The necessary maps, ancillary data, and the latest available crop information for the U.S., India, and U.S.S.R. sample segments have been obtained and will be reproduced and entered into the segment packets prior to startup of processing.

The available maps and the limited amount of ancillary information for the Southern Hemisphere countries will be provided to the CAMS analysts. A complete set of information is not anticipated to be available for the Transition Year data processing. However, the best available information will be obtained and used in the most advantageous manner.

5.1.3 CAMS ANALYSIS APPROACH

5.1.3.1 Data Processing Schedule

Segments in the U.S. Great Plains will be processed in real time, commencing in early January 1978. The CAMS estimates will be

made to support the CMR's scheduled for February 17, March 8, April 10, May 8, June 8, July 10, August 8, September 8, and October 10, 1978. Activities preparatory to analysis are expected to begin in late December 1977. The specific strategy will be documented in a forthcoming plan as indicated at the beginning of this section.

The U.S.S.R. winter- and mixed-wheat segments will be processed to support the periodic CAS reports scheduled for February 1, June 1, and September 1, 1978. CAMS processing is anticipated to begin in November 1977. The details of the early season processing are contained in appendix C.

CAMS is scheduled to begin processing of sample-segment data for the State of Punjab in India in late January 1978. This processing is planned to continue on a near real-time basis to support the CMR's scheduled for February 21, March 21, April 21, and May 19, 1978. The India Processing Plan is scheduled for release on January 9, 1978.

In the Southern Hemisphere, all Australian segments will be processed commencing in late October or early November 1977 to support a midseason CMR scheduled for December 22, 1977. (See appendix B for the Australia Processing Plan for December CMR.) The Landsat will have begun gathering these data on August 6, 1977.

Argentina and Brazil acquisitions beginning on April 15, 1977, and May 1, 1977, respectively, will be retrospectively processed by the GSFC from the Brazilian ground station recorded data tapes. It is anticipated, however, that the early season data from Brazil and Argentina will not be available in time to support the midseason CMR to be issued on December 22, 1977. A midseason report for Argentina and Brazil could be issued, depending upon the date of the arrival of the data from Brazil and upon time

and resource requirements. The decision to process the data for a midseason report will be delineated in the Southern Hemisphere Processing Plan for March Report to be issued by February 10, 1978. In any case, the Brazil and Argentina data will be processed at least once in February/March 1978, coincident with the second processing of Australia data. This will provide at-harvest estimates for all Southern Hemisphere countries to be included in a CAS report scheduled to be issued on March 28, 1978.

5.1.3.2 Country Operations Startup

Screening activity similar to that used in beginning Phase III operations for U.S. and U.S.S.R. spring wheat is planned to be implemented for commencing Transition Year operations in each of the countries. The early season acquisitions will be monitored and screened to determine their usability in making a reasonable estimate. Those which exhibit sufficient emergence and/or acquisition history to enable an estimate to be made will be worked; and the remainder will be returned to the segment packet and used with later acquisitions in making estimates, as appropriate.

5.1.3.3 Wheat/Small-Grains Estimates

It is planned to implement procedures during the Transition Year for direct determination of wheat. This represents an expansion and strengthening of the approach tested in a pilot mode in Phase III for North Dakota spring wheat. The decision to operationally extend this technology to other LACIE areas requires development of decision logic guidelines for the separation of wheat from the relevant confusion crops. Thus, it is planned to incorporate the direct wheat determination procedures for the Transition Year countries within the limits of technology developments for specific areas and within the available resources which would be required for implementation of their approach.

For the U.S. Great Plains data, it is planned for CAMS to produce and forward to CAS wheat and small-grains estimates for all segments. CAS will aggregate and report direct wheat estimates. The small-grains estimates will be held in abeyance until further definition is made on their appropriate utilization.

For the U.S.S.R., CAMS would produce and forward to CAS wheat and small-grains estimates, as resources allow, with priority given to producing timely small-grains estimates. It is planned for CAS to aggregate ratioed wheat estimates obtained from the small-grains estimates. The direct wheat estimates would be used for internal Accuracy Assessment evaluation.

For the Southern Hemisphere countries and India, it is planned to produce and aggregate direct wheat estimates, except for the November/December processing of Australian data (because of the unavailability of procedures for making direct wheat estimates for this specific area). Any small-grains estimates produced in the procedure would be saved for future use.

5.1.3.4 Improved Emergence Estimates

Procedures for making improved emergence estimates are being developed for the U.S. Great Plains and for the U.S.S.R. It is planned to implement these procedures coincident with the beginning of processing, as detailed in the schedule discussed in subsection 5.1.3.1.

The concept of early season estimation is one which would have minimum impact on operations. That is, no new software or drastic procedural changes are planned. The approach is to use logic similar to the technique developed in Phase III for determining wheat/small grains, which involved postclassification labeling using spectral aids. That is, normal interpretation procedures are employed and batch runs executed to produce an

estimate of spectrally visible wheat. Subsequent to the batch run, the analyst will take the results of the run and manually employ bias correction factors to the batch results to arrive at an estimate of total wheat.

These procedures are planned to be implemented for the U.S. February, March, and April CMR's and the U.S.S.R. February CMR.

5.1.3.5 New Sampling Strategy

A new sampling strategy was developed and tested in Kansas, North Dakota, and three oblasts in the U.S.S.R. during LACIE Phase II. The evaluation of this test indicated that equivalent precision could be obtained for the LACIE estimates and could be obtained with fewer segments than were used during Phase III. The test of the new sampling strategy will be expanded during the Transition Year to include the U.S. Great Plains.

5.1.4 YIELD ESTIMATES AND CROP CALENDARS

5.1.4.1 Yield Estimates

The yield models are operated remotely from the NOAA Center for Climatological and Environmental Assessment (CCEA) at Columbia, Missouri, on a computer at the National Meteorological Center (NMC) at Suitland, Maryland. The yield predictions and their associated data are produced monthly for each operational LACIE country and provided to the YES at JSC. Yield data are scheduled to be received as follows: the 4th working day of each month for the United States, beginning in December 1977; the 9th working day for the U.S.S.R., beginning in January 1978; the 12th working day for the Southern Hemisphere, beginning in October 1977; and the 15th working day for India, beginning in December 1977.

The yield data are produced in two formats: (1) A hardcopy form is received via terminal at JSC and is transferred to and maintained on file in the Green Room, and (2) a computer-compatible tape (CCT) is mailed from the NMC to the LACIE Commodity Control Officer at JSC.

5.1.4.2 Crop Calendars

The ACC model is operated remotely from the CCEA at Columbia, Missouri, on a computer at the NMC (Suitland, Maryland). An update of the ACC data for the Transition Year countries is received biweekly. These updates are produced and then received at JSC in two formats: (1) A hardcopy printout is obtained from a time-sharing operation file at the NMC via terminal, and (2) a magnetic tape is mailed from the NMC to the YES operational meteorologist.

After their receipt in hardcopy format via terminal, the ACC data are plotted and analyzed on the appropriate country maps. These maps are included in the Weekly Meteorological Summary. The data contained on the magnetic tape are processed to obtain adjustment values for each LACIE segment for each Landsat overflight. Multiple copies of these sample segment reports are forwarded to the CAMS image analysts.

5.1.5 CAS MONTHLY REPORTS

The CMR's will be produced as previously stated in subsection 5.1.3.1. All Application Evaluation System (AES) operations are based on this schedule.

For the United States, winter- and spring-wheat estimates received from CAMS and yield estimates from the CCEA will be aggregated to produce reports of area, yield, and production, with statistics, at the state and regional levels. These reports will be produced monthly from February through October 1978.

U.S.S.R. early season, midseason, and at-harvest CAS reports are scheduled to be produced for the Transition Year. CAS will aggregate and report ratioed wheat estimates from the small-grains estimates provided by CAMS. Country-level reports of area, yield, and production, with statistics, are planned contingent upon sample estimation techniques.

For the Southern Hemisphere, midseason reports are planned to be issued for Australia, Argentina, and Brazil. A country-level at-harvest report also is planned for all three countries.

Monthly reports of area, yield, and production are scheduled for India from February through May 1978. Reports will be made at the state level, with statistics.

5.1.6 ACCURACY ASSESSMENT

The Accuracy Assessment support in the Transition Year will be designed to provide timely evaluations of LACIE production, area, and yield estimates throughout the season, as well as more in-depth evaluations of Transition Year processing.

Accuracy Assessment will issue quick-look reports during the Transition Year as follows:

- United States - nine reports
- U.S.S.R. (LACIE) - three reports
- U.S.S.R. (USDA ATS) - five reports
- Australia - four reports
- Argentina - three reports
- Brazil - three reports
- India - one report

In addition, four interim reports will be produced, leading to the final Transition Year report, according to the following schedule:

<u>Date</u>	<u>Report</u>	<u>Content</u>
May 15, 1978	First interim	Winter-wheat estimates
August 15, 1978	Second interim	Winter-wheat and early spring-wheat estimates
November 15, 1978	Third interim	Winter- and spring-wheat estimates
March 1, 1979	Fourth interim	Winter- and spring-wheat estimates
May 1, 1979	Final	Winter- and spring-wheat estimates

5.2 USDA ATS SUPPORT

The USDA ATS is scheduled to process 72 mixed-wheat segments in the U.S.S.R. during December 1977 and January 1978. Then, in the spring of 1978, full-scale processing of approximately 800 U.S.S.R. segments is planned. The Phase III sampling strategy is expected to be used for the Transition Year.

It is planned that support for the USDA ATS processing of the 72 mixed-wheat segments will be similar to that provided for Image 100 processing in Phase III; that is, the segments will be ordered, acquired by Landsat, preprocessed at GSFC, and transmitted to JSC using existing facilities and without distinction from other segment data. The USDA ATS data would be stored in the GDSD data bases, and specific USDA ATS segment acquisitions would be unloaded to a tape. The tape, associated film imagery (as required), and ancillary data products would be provided to the USDA ATS to facilitate the calculation of wheat area estimates.

It is anticipated that LACIE support and facilities will be utilized to prepare and submit data orders to the GSFC for the USDA ATS, as well as for the Landsat data collection and the GSFC preprocessing and data transmission. A number of major USDA ATS/LACIE interfaces have been defined in the USDA ATS Project Review and in the LACIE Operations Readiness Review. Specific operations plans and procedures can be developed as soon as these interfaces are developed.

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APPENDIX A
LANDSAT DATA ACQUISITION PLAN
FOR TRANSITION YEAR

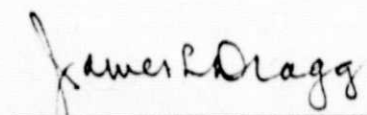
LANDSAT 2/LANDSAT-C DATA ACQUISITION
PLAN FOR TRANSITION YEAR

February 23, 1978

APPROVED:


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LANDSAT DATA ACQUISITION PLAN FOR TRANSITION YEAR

1.0 INTRODUCTION

The Landsat data acquisition plan has been developed to aid in assuring an orderly LACIE operational system during the Transition Year. The primary objective is to plan optimum utilization of both Landsat-2 and Landsat-C to meet the Transition Year requirements.

This document presents a plan for using Landsat-2 to satisfy LACIE Transition Year data requirements and a contingency mode of operation should Landsat-2 fail entirely or in part. It provides for an operational evaluation of the Landsat-C output to assure its compatibility with the LACIE operational system.

2.0 LANDSAT-2/LANDSAT-C UTILIZATION DURING TY

The LACIE operations plan for Landsat data acquisition will be to take maximum advantage of the available satellite data collection systems while maintaining a smooth data handling and processing system. Thus, it is planned to use Landsat-2 for acquisition of sample segment data for LACIE operations throughout the Transition Year. This approach will eliminate any possible perturbations in the operational system caused by converting to Landsat-C midway through the Transition Year. It will also enable a reasonable evaluation to be made of the compatibility of Landsat-C with the LACIE operating system. In addition, it should provide a greater probability of ensuring continuity between Landsat-C and Landsat-D by using Landsat-2 while it is available, thereby prolonging the life of Landsat-C.

2.1 Landsat-2 Contingency Plan Prior to Landsat-C Launch

One Landsat-2 tape recorder is still usable long after its expected life and consequently could cease functioning at any time. Therefore, it is necessary to have a backup operation planned in the event that only real-time data can be collected by Landsat-2.

Currently, data collected over the U.S. Great Plains, Brazil and Argentina are collected by ground stations and would not be affected by the loss of the Landsat tape recorder. The data collected from USSR and Australia are collected via the tape recorder and would be unavailable from Landsat-2 if the Landsat-2 data recorder should fail. Therefore, if the recorder fails, the LACIE operations recommendation is to utilize existing permanent foreign ground stations to obtain data real-time from Landsat-2 for these foreign areas. If a long delay in Landsat-C launch should occur concurrently with loss of the Landsat-2 tape recorder, the use of portable ground stations should be considered. Due weight should be given to time and cost factors vs. the desirability of maintaining a continuous data history on segments in the USSR.

3.0 LANDSAT-C LAUNCH AND GSFC CHECKOUT

The current plans at the Goddard Space Flight Center (GSFC) are to launch Landsat-C on March 5, 1978. A 6-week period is planned immediately after launch by GSFC for extensive test and checkout of the satellite. At the end of this 6-week period, the satellite would be declared operational assuming the test and checkout is successful. Thus, if the satellite is launched as scheduled, operational data could be obtained from Landsat-C beginning approximately April 15, 1978.

3.1 Plan for LACIE Operations Compatibility Test of Landsat-C

The purpose of the Landsat-C compatibility test is to ascertain the compatibility of the data from Landsat-C with the LACIE data processing system. This can be done by comparing the results of processing Landsat-C data with those obtained from processing Landsat-2 data.

A plan for the operational compatibility test of Landsat-C data will be developed and approved before March 15, 1978. This plan will include the data required, the test criteria and controls evaluation criteria and schedule for data collection, analysis, and

evaluation. The LACIE operations compatibility test of Landsat-C output will begin after GSFC has declared the Landsat-C system operational.

3.2 Outline of Operational Compatibility Test Plan

It is planned to use the LACIE data handling and processing system for data obtained from both satellites for the compatibility test. Specific arrangements for storage and retrieval of Landsat-C data would be required of ISRRS. Specific criteria, controls, and procedures would be developed by the test team for handling and processing the data. In general, however, the Landsat-C data will be collected, preprocessed, and shipped by GSFC and stored in a JSC data base. Film products would be generated and provided to the test team for evaluation.

Particular sample segments will be classified using the existing CAMS procedures and compared with classifications made for data obtained by Landsat-2 for the same segments under similar temporal conditions. An evaluation and analysis of the results of processing data from both satellites would be made and used as input to determine subsequent LACIE data collection requirements.

It is anticipated that several passes of Landsat-C would be required to obtain the data required for the operational evaluation.

Among the specific items which will receive attention are the following:

- o The adequacy of the gains and biases used in the generation of PFC film products 1 and 3.
- o A comparison of the green numbers calculated from data acquired by both satellites.
- o Relation between the data values produced by Landsat-2 and Landsat-C from passes as close together in date as possible over the same segment.
- o Effect on clustering performance of change from Landsat-2 to Landsat-C.
- o Effects of GSFC registration of Landsat-C data with Landsat-2 reference images.

- o Effects on dot labeling accuracy.
- o Effects of computing wheat estimates with Procedure-1 using both Landsat-2 and Landsat-C data together multitemporally.
- o A comparison of crop proportion estimates made from Landsat-C data with those made from Landsat-2 data for single pass analysis.

Once the evaluation is complete, the results from this compatibility test and those from any other studies will determine if and how Landsat-C should be used as a data source for the remainder of the Transition Year.

3.3 Landsat-C as a Backup to Landsat-2

Should the Landsat-2 tape recorder fail after Landsat-C is declared operational by GSFC, the primary contingency mode for LACIE Transition Year operations would be to use Landsat-C data. However, the operations and evaluation systems must be aware of the differences between the two satellites and the possible penalties of switching from one data collection system to another midway through the Transition Year.

Although the plan is to use Landsat-2 for LACIE as long as it is operational, it may be modified if GSFC intends to use Landsat-C to satisfy foreign data collection requirements of other users. In this case, LACIE may choose to use Landsat-C exclusively at the conclusion of the compatibility test so that the Landsat tape recorder (both Landsat-2 and -C) resources are not needlessly expended.

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APPENDIX B
AUSTRALIA PROCESSING PLAN FOR
DECEMBER CAS MONTHLY REPORT

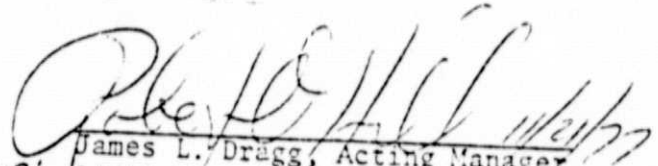
APPENDIX B
AUSTRALIA PROCESSING PLAN FOR
DECEMBER CAS MONTHLY REPORT

LACIE OPERATIONS MINI-PLAN NO. 1
AUSTRALIA PROCESSING FOR DECEMBER CMR

APPROVED:


Robert O. Hill, Head
Operations Section

APPROVED:


James L. Dragg, Acting Manager
For: LACIE Transition Project

I. INTRODUCTION

The first CMR of the Transition Year is scheduled for December 22, 1977, and will report the area, yield, and production estimates for Australia.

This mini-plan describes the operations strategy for processing the Australian data.

II. CAMS PROCESSING STRATEGY

The processing strategy has been developed with the primary consideration of supporting two Australian reports: (1) "mid-season," and (2) end of season/post harvest. To this end, attempts have been made to provide appropriate sequencing of acquisitions to allow sufficient temporal spacing of available data while still preserving the intent of the mid-season analysis.

The initial screening by CAMS of data received at JSC indicates a crop development of about 3.0 - 4.0 on the Robertson scale. However, about 1/3 of the segments received have but one acquisition. Another 40% have two acquisitions and may not have enough distinction between them to enable a reasonably accurate estimate to be made. In addition, no early season acquisitions are available to observe the crop development. This situation will be improved with the receipt of data from a Landsat pass over Australia which began on October 20, 1977, and is yielding biowindow-3 data. These data began arriving at JSC on November 1, 1977, and will likely continue to arrive until about November 15-18, 1977.

Briefly, the plan for processing the Australia data is as follows:

1. Begin the processing by putting into work those segments which have received biowindow-3 data and at least one previous acceptable acquisition, or which have three or more acquisitions and are likely to produce a good estimate.
2. As new satellite data are received from the October pass, additional segments will be metered into CAMS based upon the above criteria and CAMS workload requirements.
3. Segments which do not receive data from the late October/early November pass will be considered on an individual basis to determine if there is sufficient information to support an estimate.
4. Every attempt will be made to include biowindow-3 acquisitions (from the late October/early November) pass in the analysis. Based on the nominal crop calendar data presently available, it appears that these data would represent a crop development stage between 4.0 (heading) and 5.0 (soft dough).

5. Data from subsequent passes (after mid-November) will be withheld from the packets until analysis for the December 22 report is completed. The rationale for this is that these data will generally reflect late season estimates, and should not be processed until analysis for the end of season report commences.

It is anticipated that about 200-225 segments will be candidates for CAMS analysis. Thus, with a starting date of November 14, 1977, and an end date of December 15, 1977, (5 weeks) CAMS will be required to process an average of 40-45 segments per week. However, a few days will be required to "prime" the system in the beginning and to allow the batch products to be received and analyzed prior to December 15, 1977. Thus, the actual CAMS output requirement may be about 50-55 segments per week.

III. CAS AGGREGATION STRATEGY

The CAS plans to utilize the current ratios to obtain wheat estimates from the small grains estimates received from CAMS. These ratioed wheat estimates and the yield estimates, currently scheduled for delivery the twelfth working day of December, 1977, will be aggregated to produce a full-country area, yield, and production report for Australia. The scheduled completion of this report is December 22, 1977.

IV. ISSUES WITH POTENTIAL OPERATIONS IMPACT

- Utility of current segment allocation for Australia - The initial area delineations as compiled in 1974 are in error. These are currently being revised by CAS to conform with the figures published by the Australian government. Estimated completion date for this activity is mid-December. This may jeopardize publication of a report in December by CAS. However, the intent of the December "mid-season" report can still be preserved in the aggregation process.

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APPENDIX C

U.S.S.R. EARLY SEASON PROCESSING PLAN

APPENDIX C

U.S.S.R. EARLY SEASON PROCESSING PLAN

I. INTRODUCTION

This document describes the operational approach for processing USSR mixed wheat and winter wheat data to support the USSR Early Season Report, scheduled to be issued by CAS on February 1, 1978.

II. SYSTEMS AND PROCEDURES

The LACIE-6A system for processing data on the GDSD 360/75 computer will continue to be utilized by CAMS until after the LACIE-7 system originally scheduled for delivery on November 22, 1977, is evaluated and after the CCIT interface software is implemented on the PDP 11/45. The CCIT software is scheduled to be delivered on December 8, 1977 thus the LACIE-7 system will be implemented subsequent to this date.

The CAMS procedures for producing improved emergence estimates have been presented to the CPAT and to the PMS with approval given for implementation. It is planned to use these procedures as presented for providing improved emergence estimates in the USSR.

III. CAMS PROCESSING STRATEGY

CAMS will plan to work all segments in the USSR pure winter wheat and mixed wheat areas which have received a set of

workable acquisitions. A potentially good set of acquisitions has been defined as one with at least two non-consecutive day acquisitions, one with bare ground and one with crop emergence. This definition should provide CAMS with a sufficient acquisition history and sufficient crop development to permit analysis of the data.

The meteorological summaries indicate that further crop development in the mixed wheat region was not likely after early October and that the wheat in nearly all of the USSR had gone into dormancy after the middle of October. Thus future early-winter acquisitions in the mixed wheat region are not expected to significantly aid the CAMS analysis for the February report.

However, because the weather conditions are usually less severe in the winter wheat region, the additional Landsat pass ending November 6, 1977, is expected to provide additional useful information to aid the CAMS analysis for the February report.

Using this as a criteria for putting segment data into work in CAMS:

1. The mixed wheat data will be assigned to the analysts first and then,
2. The winter wheat data will be put into work in a general north to south progression across the winter wheat region and including acquisitions from the Landsat pass which ended about November 6, 1977.

IV. CAMS PROCESSING REQUIREMENTS

There are approximately 250 candidate segments available for CAMS analysis. The possibility exists that with the completion of the early November Landsat pass over the winter wheat region, 150-200 additional segments will be candidates for CAMS analysis.

Thus CAMS will be required to analyze about 400-450 segments for the USSR early-season report. This will require a weekly average output rate by CAMS of 55-65 segments per week with a 7-week processing period from mid-November to the end of the first week in January. However, with the time required to prime the system and considering the holidays, the output requirement could reach 75-85 segments per week.

It is desirable to complete the processing of the majority of the USSR early-season data prior to January 6, 1978, to preclude any competition of GDSD resources between it and the processing of U.S. data scheduled to begin the first week of January, 1978.

V. CAS REPORTING SCHEDULE.

It is expected that the last date to deliver CAMS estimates to CAS for inclusion in the early-season report is January 24, 1978. The yield data are scheduled for delivery on January 12, 1978. The CAS USSR Early Season Report is scheduled to be issued February 1, 1978.

NASA-JSC